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HELIOPHYSICS SUBCOMMITTEE

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MEETING MINUTES

Maura Hagan, Chair

Ramona Kessel, Executive Secretary

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Monday, March 30, 2015

Welcome, Overview of Agenda

Dr. Maura Hagan, Chair of the Heliophysics Subcommittee (HPS) of the NASA Advisory Committee (NAC), opened the meeting. After taking roll of the HPS members, Dr. Hagan reviewed the agenda, then announced the first speaker.

Heliophysics Division Overview

Dr. Jeffrey Newmark, Interim Director of NASA's Heliophysics Division (HPD), presented an overview of the Division's activities, starting with the recent launch of the Magnetospheric Multiscale (MMS) mission. The launch was perfect, which was impressive given the complexity involved in deploying the mission's four spacecraft. NASA received great press on this. The commissioning is going well.

At the Smithsonian, the Air and Space museum now has a permanent exhibit of Solar Dynamics Observatory (SDO) data streaming, and the American Museum of Natural History has a room dedicated to SDO. NASA recently marked the observatory's fifth anniversary. In other activities, NASA recently refined the shape of the heliosphere and learned how ionospheric "froth" might affect GPS communications. Dr. Jonathan Cirtain, of NASA's Marshall Space Flight Center (MSFC), received the 2015 Karen Harvey Prize by the Solar Physics Division of the American Astronomical Society (AAS).

HPD objectives and programs center on four elements: Solar Terrestrial Probes (STPs); the Living with a Star (LWS) program; the Explorer program; and research. The Heliophysics System Observatory (HSO) is a coordinated fleet of 18 missions on 29 spacecraft. There are also five missions in development. It is important to view this as a system.

Over the next 3 years, HPD will launch spacecraft valued at an investment of about \$4 billion, covering a tremendous range of science for heliophysics. Future efforts will be aimed at significantly increasing the cadence of Explorers, in keeping with the recommendations of the Decadal Survey (DS). HPD hopes to have an Explorer Announcement of Opportunity (AO) in Fiscal Year 2016 (FY16), and an STP AO in FY17. In addition, the Division could launch a Mission of Opportunity (MOO) as early as 2020, and small-to-mid Explorers after that. HPD aims to have most missions launch 4 to 5 years after the AO, with Explorer AOs occurring about every 3 years; they will alternate between small and mid-sized. HPD will also offer MOOs along with those AOs, as a lot of interesting science could be done with partnerships. MOOs are not tied to specific launches. The mission timeline from 1995 to 2025 indicated a linear growth in missions.

The President's FY16 budget request included some significant growth in the research program in the notional years, in addition to some immediate growth. The DS recommendations and the community desire for enhancing the research program will be realized with this budget. The Solar Probe Plus (SPP) mission just selected a launch vehicle that is within the allocated budget. While this is a significant cost, it is now fixed, and the mission is on schedule and on cost. The Critical Design Review (CDR) was just completed and went well. The Ionospheric Connection (ICON) and Global-scale Observations of the Limb and Disk (GOLD) missions have both been through Key Decision Point C (KDP-C), and are now confirmed with launch dates.

Cluster will not be supported after this year, based on the recommendations of two consecutive Senior Reviews, which analyzed the science return against the cost. About 1 year ago, the team was notified that this would be the last year. The Senior Reviews are available online. Dr. Mona Kessel, HPD Program

Scientist and HPS Executive Secretary, pointed out that the European Space Agency (ESA) is the primary partner for this mission and will continue to support it.

Dr. Newmark listed HPD's planned accomplishments for FY15 and FY16. These include the upcoming CDR for ICON and continued support for the Solar Orbiter Collaboration (SOC) with ESA. SPP will go up to KDP-D in FY16. SDO and the Interface Region Imaging Spectrograph (IRIS) are completing their prime missions in 2015 and will be part of the 2015 Senior Review that is scheduled for the spring. The sounding rocket campaign continues, with up to 20 missions.

In regard to the next Research Opportunities in Space and Earth Sciences (ROSES) call, there was an HPS teleconference in January about the Guest Investigator (GI) and Supporting Research (SR) elements of the Research and Analysis (R&A) program. Based on that discussion, HPD did not combine the two elements and planned separate calls. There was some rewording to strengthen the difference between the two programs, however. The GI program focuses on data analysis, while SR combines data analysis and numerical modeling in a larger effort using a variety of techniques. HPD program managers would appreciate any additional feedback in order to continue differentiating the two programs. Dr. W. Kent Tobiska asked about the community response on the GI first-step proposals. Dr. Newmark replied that there were 200 proposals, which is an increase of 15 percent and which exceeds the budget increase. Further discussion of the differences between GI and SR was deferred until later in the meeting.

Dr. Newmark next discussed the Science Mission Directorate (SMD), of which HPD is a part. HPD does fundamental physics that feeds into many of the almost-100 missions under SMD. In FY16, the SMD budget strategy includes collaboration across divisions. In addition, the Space Technology Mission Directorate (STMD) has done work that is directly applicable to heliophysics, in areas such as optics, solar sail, and more.

In recent years, SMD has been using a revised cost-estimating procedure that has proven very effective in managing budgets. HPD does a good job in particular. Costs are set at confirmation. Dr. Ralph McNutt said that while the General Accounting Office (GAO) and NASA have cost data, there are public debates about over- and under-runs, which end up becoming hearsay. The GAO costs do not match with those of NASA. It would be good to have something people could refer to, because a strong track record might be a good thing to promote. As it stands now, an interested person must do a lot of work to dig out the costs from online sources; it is not simple. Dr. Newmark said that this is something HPD could look into.

HPD continues looking at balance when planning. It would be good to have some smaller missions to complement this decade's many large missions. HPD wants to get the system science done, and the large missions take more time, while small missions are faster to launch. At the same time, the heliophysics missions are connecting into a system, and a system needs lots of little point measurements. Technology can help in this area with smallsats and cubesats that are very capable and go into a distributed system with miniaturized instruments.

SMD has been involved in restructuring science education with a more holistic perspective rather than assigning education to each mission team. SMD science as a percentage of worldwide science has been gauged at more than 16 percent in 2014, up from 6 percent in 2011. While it is important not to over-interpret this, it is an indicator that SMD science is having an impact.

Heliophysics Director Update

Mr. Geoffrey Yoder of SMD spoke about the search for an HPD director, noting that heliophysics is extremely important to NASA and especially to SMD. There have been rumors that NASA is disbanding HPD, and that is not true; it is not even being discussed.

In trying to find an HPD director, the advertisement went out, and SMD encouraged people in the community to get the word out. Once the applications came in, Human Resources looked at them for credentials and such. A panel was then set up to categorize the applicants at various levels of qualification. The “highly qualified” applicants went to another panel for interviews. Usually, that second panel recommends that NASA interview some of the candidates. In this case, however, the panel recommended a “no-select” decision, in which none of the candidates were chosen.

When hiring for Senior Executive Service (SES) positions, there are requirements for multiple leadership elements. These capabilities must be demonstrated, not just shown as potential. This is true for any SES position. Mr. Yoder added that an SES manager should be able to manage anywhere within the government. He and Dr. John Grunsfeld, SMD Associate Administrator, have been talking about this situation almost daily. They are looking at several options, which Mr. Yoder declined to specify. However, they did think it was important to address HPS due to the rumors that are flying about.

Dr. Michael Liemohn, an HPS member participating via teleconference, asked for more information about the criteria and how a highly-qualified rating is determined. Mr. Yoder said that leadership must be demonstrated in various areas. There are five leadership criteria overall, and they must be shown to have been met. The criteria include leading a diverse group, advocacy, and coalition building.

Dr. McNutt said that this was like searching for “a three-star general with five PhDs.” He noted that that was facetious, but he had serious concerns about how they could find someone with both these leadership capabilities and a good technical background. He also wondered the extent to which this problem occurs elsewhere in the government. Mr. Yoder said that one of the issues in government is that the salaries are defined and capped, so one issue is whether candidates would take a pay cut from jobs outside the government. That influences the applicant pool. He personally believes in NASA, but his salary would be significantly increased, even possibly doubled if he went to the private side.

Dr. Spiro Antiochos was concerned that the criteria are nebulous. Among all the division directors he knew of, the first criterion was formulating and advocating a science program. Everything else can be handled. He added that this is not a job for a general manager and expressed concern that there was too much emphasis on the leadership criteria at the possible expense of the technical criteria. Mr. Yoder said that there are technical qualifications that carry as much weight as the leadership criteria he mentioned earlier. Going forward, recompeting the call is probably not the answer; it would result in a long delay. There are questions about whether there are candidates that could be reassigned. HPD is doing a lot of good work now, and SMD does not want to disrupt that.

Dr. Antiochos said that if the SES candidates have to fill those criteria, SMD is eliminating the technical leaders. Mr. Yoder disagreed, stating that no SES manager could do this without the technical qualifications. There were both leadership elements and technical qualifications. Dr. Antiochos said he was very concerned about bringing in an SES without the right technical and science experience. Mr. Yoder maintained that he was not saying they would bring in any SES. He would be happy to have suggestions from HPS. No one expected a no-select decision at the start of this process. SMD hopes to complete it sooner than later and thought it would be done by now.

Dr. Vassilis Angelopoulos said that the community feeling is one of giving up on the future. There needs to be articulation of a path forward so that people will be reassured that the field is here to stay. Mr. Yoder was wary of discussing multiple paths, which could be misinterpreted. SMD will finalize this as quickly as possible. He said that he understood that the community was nervous, which is why he wanted to talk about this with HPS. HPD is not merging into another division, but he could not say anything beyond that.

Dr. Russell said that while he understood this to be a difficult situation, he was concerned about not having a target date for resolution. Mr. Yoder replied that there is an internal target date that SMD is not sharing. Dr. Jill Dahlburg asked about the technical criteria. Dan Woods of SMD said that those criteria included knowledge of heliophysics programs and the science, technology, and engineering related to them; leadership of a technical and science workforce; and ability to meet strategic program goals and advocate for them with external stakeholders. Mr. Yoder said that those remain in place but SMD will look at them.

Dr. Hagan asked about SMD plans to communicate the timeline and criteria to the community. Mr. Yoder said that he wanted to defer to Dr. Grunsfeld on that. Dr. Hagan cautioned him that people make up stories in the absence of information. Therefore, it would behoove them to find a vehicle to assuage the community's nervousness. Dr. Angelopoulos added that he did not feel they were getting an answer, stating that "we will let you know" is not an answer." He wanted to know that there was a process in place, with dates, and with a statement about the viability of the field. This is important in order to keep young people in the field. He sought a strong statement of support for the field at the very least.

Mr. Yoder said that heliophysics is extremely important to NASA headquarters, and that is why they want to do this right. It is also why they sought HPS help. On the other hand, he could not give them answers that did not exist. Dr. Russell reiterated that the community is very nervous. Some message to the community of NASA's strong intent of continued support of the field would be very important. Mr. Yoder said that that was good point, and suggested that he and Dr. Grunsfeld could draft such a statement and send it out. Dr. Grunsfeld has been talking to people both inside and outside of the heliophysics community about the various options.

Dr. Tobiska said that the concern in the community has not been only recent. It has been due to the culmination of the events since 2012. One recommendation is to address what has evolved and transpired over the last few years, and how that is changing. Mr. Yoder said that he would talk to Dr. Grunsfeld about drafting and disseminating a statement of support for heliophysics.

Heliophysics Division Overview, continued

In response to a comment about the Heliophysics Roadmap, Dr. Newmark said that HPS members would receive bound copies that day, though it was still in prepublication and had a few typos to correct.

Dr. Neil Murphy said that regarding access to space with low-cost buses or launch vehicles, that must be enabled in a mission call. Many within the community would like to propose large-scale constellation missions, which the calls do not yet support. Dr. Newmark agreed that HPD would like to enable that, and the Division is working on how to do it. MOOs are a possibility, and there are other means, but it takes time. MOOs come with a ride already proposed. On Earth Venture instruments, there are rides with the Earth Science Division (ESD) missions. The budgets reflect whether or not there is an existing vehicle. The idea is to learn what has been authorized. This is an issue across SMD, not just for HPD. It relates to cost reliability and spacecraft reliability. The cubesats are operated under the guidelines for sounding rockets, and HPD wants it to be more formal.

Budget Update

Dr. Newmark presented a budget overview. The President's FY16 budget request shows the first real growth for HPD in a decade, with a proposed FY16 budget of \$651 million, growing to \$722 million by FY20. This budget growth meets the DS requirements, including the DRIVE budget wedge and requested resources for the current program. DRIVE, a competed PI program, has been budgeted at about \$60 million and is projected to grow by another \$40 million.

The proposed budget fully funds the operating missions. At the same time, it continues funding for the HPD missions in development, which come to about \$3.5 billion in total investment. The HPD research program has strong growth in all of its elements beginning in FY16 and going forward. Dr. Newmark noted that there are some pass-throughs in the budget, as always. The Explorer program, the second-highest DS priority, has strong budget growth in the notional out-years, and the cadence will match the DS recommendation.

The third DS priority is strategic mission lines: LWS and STP. The proposed budget for these is healthy. Funding levels are set at mission confirmation, and the money is allocated as required. The current plan is to have Explorer AOs in 2016 and 2019, with an STP AO in FY17. At that point, STP will go to a cadence of every 5 years, possibly even every 4 years.

The President's FY16 budget for HPD includes \$158.5 million for research, \$343 million for LWS, \$50.5 million for STP, and \$98.9 million for Explorers. Due to a decrease from a pass-through on research, however, an overall increase looks like a decrease. It would be informative to break this out, as HPS has recommended in the past, but government budgetary lines are hard to change. The Explorer budget reflects the shifting nature of the calls and funding, as well as the cadence. He was not sure about the timing for the next LWS AO.

A more detailed breakdown of the research budget shows that R&A includes part of DRIVE in FY18 and FY19. More STP funds become available in FY19 and FY20. The STP line shows MMS as a 2-year mission, but it will likely go beyond the prime phase. This would require going to Senior Review, and the costs would be allocated differently, though the total would not change.

Dr. Newmark reviewed Explorer funding from 2007 through the 2016 request. In 2007, there were more shared SMD items parked in the HPD budget; as they were moved out, there was the appearance of a decrease, but that was not funding for heliophysics science. The core heliophysics funding has not changed much. He expressed optimism about launch costs, some of which are going down as new, competitive launch vehicles become available.

It is difficult to get accurate numbers for the current fiscal year because there is ongoing work on allocation of those funds. From 2004 on, the competed PI-led program budget has been flat. This includes the GI and SR programs, along with others. Though it would be hard to break out the exact numbers, it has been in the range of \$62-63 million. Proposal pressure stems from a number of factors, including inflation, salary increases, and growth in the field. It all adds up.

Flight Program Status

MS. Sandra Smalley provided an update on the HPD flight program status. ICON was confirmed in October, which included the addition of a second Ion Velocity Meter instrument and adjustment of the launch date to better coincide with the Launch of GOLD. GOLD was confirmed on March 3, 2014. ESA adjusted the SOC launch readiness date to October 2018. The Program Implementation Review (PIR) was successfully completed for the Living with a Star, Solar Terrestrial Probes, and Explorers programs in October 2014. Within the past month, MMS had a spectacular launch and deployment and SPP successfully passed CDR. HPD also launched a number of sounding rockets.

Concerns and issues include sounding rockets, the Peregrine motor development, and the Solar Terrestrial Relations Observatory (STEREO) were discussed. The sounding rocket issue involved a proposed wilderness area designation for Poker Flats. The Fish and Wildlife Service acknowledged NASA's need to continue using Poker Flats and noted the Agency's record of being a good steward. The Peregrine fire test at MSFC was unsuccessful. This affects three launches and is being studied further. Superior conjunction reduced science data on Stereo A and B through 2016. Additionally, an anomaly on

STEREO B resulted in a loss of communications. A Failure Review Board (FRB) was convened and the report was published in March.

The Formulation and Development chart indicated that almost all mission elements are on plan with adequate margin. The three identified problems are minor. The successful launch of MMS has been followed by the completion of the mag boom deployment. The CDR for the Solar Orbiter is ongoing with an expected completion in the June time frame. The GOLD Preliminary Design Review (PDR) took place in December and instrument maturity exceeded expectations. The ICON mission was confirmed as well.

The STEREO blackout remains an issue. The mission team lost all contact with STEREO B in October. The recently completed Failure Review Board determined that there is a chance for recovery. Dr. Jeffrey Hayes added that the team hopes to communicate to turn the instruments off to allow the batteries to recharge then send a series of commands to regain control of the spacecraft. There will be another attempt starting in late April, and NASA is working with others to utilize antennae assets. Ms. Smalley said there was also an anomaly on the Wind spacecraft, but recovery efforts were successful. Overall, the missions are doing well but are not 100 percent.

Terrestrial Gamma-Ray Flashes: Dark Lightning and Other Radiation from Thunderstorms

Dr. Eric Grove of the Naval Research Laboratory (NRL) discussed Terrestrial Gamma-ray Flashes (TGFs), dark lightning, and other radiation from thunderstorms. At any given moment, there are about 2,000 thunderstorms occurring on this planet. Most of what we think of is the cloud-to-ground (CG) lightning, and we are still learning about this process. About 25 percent of all lightning is negative CG (-CG), with positive CG (+CG) being rare. Most lightning is intercloud (IC) lightning.

TGFs are the radiation from thunderstorms, intense beams of MeV energies like solar flares and with power comparable to that of a lightning strike. Gamma rays have a tremendous effect on a storm. TGFs are fast, energetic, associated with thunderstorms and lightning, produced below thunderstorm cloud tops, bright, and intense. The light ranges are still being determined. Investigators do not know how they are produced, how often they occur, the portion of energy budget of a thunderstorm that goes into TGFs, and the impact of this energy transfer on the dynamics of the atmosphere and on the climate. The last is the big question – what are the effects of that radiation on atmospheric chemistry and dynamics?

Most measurements of TGFs have been made from space. Dr. Grove noted some of the space-based discoveries in the 2000s. One of these space-based missions, Fermi, has a Large Area Telescope (LAT) and a Gamma Burst Monitor (GBM). TGFs are so bright that Fermi detects them even though it faces away from Earth. The GBM sees about 800 gamma rays per year. Celestial gamma rays are much slower than terrestrial ones. There is a limitation of not knowing what to look for, and the Fermi orbit is beyond what is needed to detect most TGFs.

A time series of TGF light curves shows that they are mostly single pulse. The gamma-ray spectra of TGFs show a hard power law with exponential cutoff. The shape at low energies is driven by atmospheric attenuation. Across the planet, the active TGF regions are the active thunderstorm regions. TGFs prefer land masses and coastal regions. The TGF rate is low in North America and the Himalayas, however.

TGFs might occur once in every 1,000 thunderstorms and can travel great distances, as shown by a graphic of a storm over central Africa, with the TGFs detected hundreds of miles north in Egypt. The Fermi LAT can be used to geolocate the flashes; the mission has been very useful in this work, even though it was outside Fermi's design.

Dr. Grove discussed the behavior and movement of electrons, noting that in TGFs, more energy is added than the electron loses. The electrons in a strong energy field accelerate to relativistic energies, radiate

Bremsstrahlung gamma rays, and create daughter electrons that accelerate and radiate. There are two primary models for this: the Relativistic Runaway Electron Avalanche (RREA) feedback model and the cold runaway in lightning leaders with streamers. Although the two theories are roughly similar, the latter predicts phenomena not yet observed, which argues for the RREA. In the RREA, the idea is that feedback seems to be essential. Relativistic feedback discharge collapses the energy field. The rapid redistribution of large amounts of charge could create a shorter field. The model is consistent with observation.

If the model is right, the normal optical emission is not significant, and the TGF channel is large and low temperature, this makes TGFs optically dim, and that is “dark lightning.” NRL did a simulation to reproduce this and applied software (SWORD) to validate the predictions. The simulation found relativistic avalanches with feedback, as well as large fluctuations and secondary avalanches. The simulation validates home-grown simulations.

SWORD does a model of a 737 to calculate the dose of radiation per passenger. The average annual dose is about 6 mSv; a TGF might double that. There has also been work on triggered lightning, which is hard to do, though an effort at Camp Blanding in Florida succeeded in drawing in the lightning, producing a return stroke that jumped. The real goal is to do airborne, in situ measurements, penetrating severe storms in an aircraft fitted out with gamma-ray detectors.

G/MOWG Report

Dr. Douglas Rowland gave an update on the Geospace Management Operations Working Group (G/MOWG). The Group last met in October at NASA and produced a range of findings, generally encouraging HPD to explore opportunities for cross-division, cross-agency, and international missions that could benefit from heliophysics involvement, especially in geospace.

For the MMS science funding opportunities in the upcoming ROSES call, G/MOWG members felt there was a competition issue in which some PIs have preliminary access to certain data. In order to level the playing field for Step-1 proposals, the MOWG recommended that proposals in competition for MMS analysis funding should only use data that is publicly available and released at least 3 months prior to the Step-1 proposal deadline. Dr. Newmark said that ROSES 15 had a specific line saying that such proposals are not solicited, but HPD will consider what to do with ROSES 16, for which the Division expects a lot of proposals involving MMS data.

Dr. Rowland presented other MOWG findings, including the need to keep the GI and SR programs separate and maintaining the balance of dedicated cubesat funding while protecting infrastructure for rockets and balloons. The MOWG believes it is very important that NASA bring in a second magnetospheric scientist. The Group would also include secondary free flyers as MOOs in the next SMEX call, as this would increase flexibility.

Dr. Antiochos said that the DS strongly supported GI funding for new missions. In order to succeed, HPD must show the success in its missions and have the funding behind it. His concern was MMS funding limitations. Dr. Newmark said that in terms of the DS recommendation for future missions to set aside a certain amount for a competed GI program, that is something HPD generally does for new missions. As for the existing missions, HPD is enhancing the GI program and other research. The question then becomes whether to take some fraction of the research funding for this, to wall off some of the new funds, or to let the proposal pressure direct it. This has not yet been discussed for FY16.

Dr. Liemohn said that there was an interdisciplinary science call for MMS, and there are people beyond the immediate instrument team who have been contributing to the process. Dr. Angelopoulos said that in regard to the GI program, the missions together enable the observatory, so HPD might want to coordinate this with proposals. Dr. Rowland said that it would make sense to discuss having proposals for a

campaign. Dr. Antiochos noted that HPD has invested heavily to have MMS as the flagship, so if extra resources are needed to get the science, those resources should be obtained. It is important that MMS create science news.

HPS Discussion

Dr. Tobiska said that the airborne side is often lumped in with balloons, rockets, and cubesats. However, interesting heliophysics science is taking shape using aircraft. There are many different platforms and, going forward, it might be worthwhile to look at these smaller platforms to see how to expand the science. Dr. Newmark confirmed that airborne is based in ESD. APD pays for the balloon program, but payloads come from the originating divisions.

Dr. Hagan identified three potential findings based on the morning's conversation. First was the path forward for HPD, which she wanted to discuss the next day. Another area was access to space, specifically via constellations, and the third had to do with language differentiating the SR and GI calls. Dr. Liemohn agreed with Dr. Antiochos about obtaining sufficient science from a new mission, and suggested having a related finding. Dr. Hayes explained that in APD, every new mission has a Guest Observer (GO) line associated with it, which can result in 200 papers per year. In HPD, the GO equivalent is GI, though the latter is broader. Dr. Newmark added that APD has specific pointed observations for GOs, whereas HPD's are more survey-oriented.

Two-Step Process Update/Assessment

Dr. Kessel explained that while the NAC Science Committee had asked all of the subcommittees to discuss a two-step proposal process, HPD was the first SMD division to actually try it. The goals were to streamline the proposal process, reduce the workload, and cut expenses while maintaining high standards. One of the biggest expenses is bringing people to the panels, which often requires recruiting reviewers from overseas.

A 2013 peer review panel of civil servants provided initial data, followed by a 2014 mail-in review. The two-step process began with a Step 1 proposal that included three elements: a description of the science goals and objectives; a brief description of the proposed methodology; and a brief work plan. The Step 1 reviews resulted in a discourage/encourage decision. Discouraged proposals were allowed to submit to the Step 2 phase, and Step 2 reviewers were not informed of the Step 1 decisions. However, HPD staff are allowed to consider it.

Program data for 2013 show the percentages for the encourage/discourage decisions. Overall, the Step 1 review encouraged 42 percent of proposers to submit to Step 2. This was in range of what the Division wanted, resulting in a roughly one in three or four chance of funding for the encouraged proposals. Not a lot of discouraged proposers submitted to Step 2, only about 13 percent. The basis for discouraging proposals was 56 percent programmatic, 27 percent scientific, and 12 percent both. The programmatic discourage decisions were often because the proposals were too long, not focused on mission goals, or not focused on data analysis. Only one discouraged Step 1 proposal was recommended for selection in Step 2, and while it was not the highest priority science, there were few higher ranked proposals in that area.

Overall, the results for 2013 were unclear on whether the two step approach streamlined the process or reduced the NASA workload. It did reduce the workload for the science community and lowered the expense for preparing and reviewing full proposals. The process also managed to maintain high review standards.

Dr. Angelopoulos said that he had heard from proposers discouraged in Step 1 that they did not know the reason for the rejection. It would be good for them to receive feedback. Dr. Kessel said that proposers were told that they could get feedback if they contacted the program officers after Step 2. It would be an

unfair advantage to do that before then. It might be possible to send out the Step1 decisions, but it would have to follow Step 2. Dr. Tobiska suggested feedback to all Step 1 proposers along the lines of “you didn’t pass programmatic criteria” or “yes, you passed all criteria.” Dr. Kessel said that the fairness issue is paramount, though HPD can discuss his suggestions. If Step1 feedback creates more work, that defeats the purpose of the new process. Dr. Hagan suggested that more data are needed.

Dr. Kessel then presented the data from the 2014 ROSES call, which used the two-step review process for the GI and SR programs. Out of 35 GI proposals, 17 were encouraged, 14 were discouraged, and 4 were deemed noncompliant. Only one discouraged Step 1 proposal was submitted for Step 2, and it did not win.

Dr. Arik Posner of HPD next presented the results of the H-SR of ROSES14. He said that part of the SR program was delayed due to recent staffing changes, therefore there were two Step 2 due dates. The selections of the delayed solar subset are not yet completed, but the reviews were held. Almost all proposers who were encouraged in Step 1 submitted for Step 2. The data show that the discouraged proposals submitted for Step 2 had success rates similar to those of the encouraged proposals. Dr. Newmark observed that it was possible that the discouraged proposers were motivated to write a better proposal. Of the proposals with a completed selection process proposals were funded at a slightly lower rate.

Dr. Posner next presented data on the PI gender breakout, given that in a three-page proposal the material to judge on is more limited than in a full proposal, so that there is a possibility that reviewers are influenced more by what they know about the PI. Male PIs had a slightly higher likelihood of being encouraged (54% vs. 49%). Dr. Hayes added that research by the Space Telescope Science Institute (STScI) found a small but persistent gender bias. However, this has been flipped in favor of female PIs in a couple of areas, and that is especially true among younger scientists. Dr. Posner said that HPD hopes to analyze why some highly rated/selected proposals were discouraged, and why some proposals rated low in Step 2 were encouraged in Step 1.

Discussion of Two-Step Process

Dr. Antiochos said that these issues point out that Step 1 should be a true selection process. The community favors this because no one wants to submit a 15-page proposal, but since resubmission of discouraged proposals is allowed, some investigators might focus on the 15-page proposal and pay less attention to the Step 1 proposal. Dr. Dahlburg commented that if Step 1 would not be an absolute down-select, investigators would still think about the 15-page proposal in writing the 3-page proposal.

Dr. McNutt advised throwing out those proposals that fail for programmatic reasons or noncompliance. Dr. Kessel explained that for some of the proposers, it was only the references that made them exceed the page length. HPD did not think it would be fair to exclude them since they are accustomed to references being excluded from the total page count. However, that was just for the first year.

Dr. Tobiska was concerned that there may be a few gems or nuggets that are discouraged. Dr. Murphy said he would not make any significant changes in this process, as it serves the intended purpose. There is not yet enough information to determine if anything needs to be done differently. He would not change the way the feedback is given.

Dr. Desai agreed that there is not yet sufficient information to turn Step 1 into a down-selection. He advised trying this for another couple of years to see what happens with the discourage rate. Dr. Antiochos said that trials increase work. It is the proposers’ responsibility to make their submissions compelling. He expects that there will be more and more submissions from those discouraged in Step 1, since they have no reason not to continue.

Dr. Dahlburg expressed her support for the two-step process, as it helps the proposers with their planning process. She agreed that it would be premature to change Step 1 at this point. Dr. Russell liked that those who have participated thus far are reporting better odds of selection if they pass Step 1. Dr. Posner noted that some analysis and selections were still pending, and Dr. Kessel pointed out that in the GI program, few of the discouraged proposers submitted in Step 2, while in SR, one third did. It will not be possible to change to a binding review on Step 1 before 2016. Dr. Hagan said that the HPS is divided about whether Step 1 decisions should be binding in the future, and this is consistent with what she heard in the last Science Committee discussion. Dr. Kessel added that HPD had more funding than expected, resulting in discouraged proposers who would have been encouraged had the funding level been known.

Dr. Liemohn asked about the extent to which HPD used the Step 1 decisions in making the final selections. Dr. Posner said that he did not use that information; Dr. Kessel said that the use of that information was optional. Dr. William Patterson said that HPD would only look at those decisions if the program managers needed additional insight. He did not look at the Step 1 decisions. Dr. Liemohn noted that in one of the Planetary Science Division (PSD) programs, there were two separate Step 2s because of the high number of conflicted reviewers and panelists. Those who submitted were not competing with those they were reviewing, which was an interesting approach.

Dr. Max Bernstein from PSD said that some in the community were not happy about having two Step 2 deadlines. However, this is a valid approach that is used elsewhere. The AO goes out, there are two groups, and each group reviews the other. The program is huge, so this is a necessity. The funds are separated proportional to the number of proposals, so there is no incentive to hold back on accepting a proposal. PSD was not very aggressive in the discourage decisions, however, and encouraged about 80 percent of the proposers to go on to Step 2.

Dr. Hagan asked for a vote on whether to make Step 1 definitive. She and Drs. Hughes, Antiochos, and Angelopoulos voted in favor of doing so. All other HPS members voted against making Step 1 definitive at this time. Dr. Hagan suggested that HPS have a finding on this topic, and asked Drs. Hughes and McNutt to draft one, noting that the vote was not unanimous.

HPS Discussion

Dr. Hagan said that the HPS should develop findings addressing the G/MOWG findings, one on the GI and SR issue, and another regarding whether to have specific language in the call for targeted language for MMS or to let proposal pressure dictate. Dr. Murphy asked if the language regarding MMS would allow data from other missions. Dr. Newmark replied that the majority of the proposed work should involve MMS, but using multiple elements is encouraged, not discouraged. Dr. Angelopoulos favored having proposal pressure dictate distribution of research funds. Dr. Antiochos held that HPD must have a successful MMS, which is a strong argument for asking the community to focus on it. Dr. Kessel said that experience showed that MMS is likely to generate many proposals.

Dr. Hagan next turned to HPD staffing issues. The additional staff position that is about to be filled may be a start, but she did not think it would solve the problem. Dr. Newmark noted that the Division could seek detailees. He would like to add another person or so in addition to the approved position, and he expects the Division to receive more slots. Dr. Kessel said that hiring such individuals and getting them up to speed takes time. Additional civil servants are needed to manage competed science programs and work with missions, among many other tasks. There is no one on the Grand Challenge research, and the Division could use someone there, especially as the science centers are put together. Dr. Hagan said that just stating that HPD needs more people is not compelling. She asked HPD to help identify the holes so that HPS could address the gaps in a finding. It is important to be as specific as possible.

Dr. Tobiska said that for the follow-on discussion Dr. Hagan just proposed, it would help HPS to have an understanding of specific areas that might not be served. Dr. Hagan added that she envisioned a presentation identifying existing expertise, where the growth is, and what is anticipated for the future. That way, HPS can help echo the Division's requirements. She did not think they had sufficient information yet and was unwilling to put forth something that was too shallow.

Dr. Hagan listed the following as potential findings for discussion, with those committed to work on them, noting that the concepts might not all go forward:

- Differentiating language in GI and SR: Drs. Russell and Antiochos
- Launch capabilities for constellation satellites: Drs. Angelopoulos and Murphy
- Path forward for HPD: Drs. Dahlburg, Murphy, and Desai
- Feedback on the two-step process: Drs. Hughes and McNutt

Dr. Liemohn suggested a finding in support of the proposed budget increase, noting that the additional funds reflect DS priorities. He volunteered to draft it. Dr. Tobiska agreed to help him.

Regarding whether to set aside GI funding for MMS, Dr. Dahlburg suggested that the practice with other flagship missions could provide a template. Dr. Antiochos said that the important thing is giving the community the opportunity to participate in a flagship mission during its prime phase. Dr. Hughes disagreed, maintaining that proposal pressure is the best way to go. Dr. Newmark said that both STEREO and the Interstellar Boundary Explorer (IBEX) had dedicated R&A funds.

Dr. Hagan advised coming back to the issue when there is more information. She then adjourned the meeting for the day.

Tuesday, March 31, 2015

Senior Review Guidelines

Dr. Hayes presented highlights of the upcoming Senior Review, which is Congressionally mandated and occurs every 2 years. The information from the Review will be made public after its completion. Dr. Hayes noted that an internal NASA study of the SMD divisions found that HPD and APD did very well in meeting the standards for Senior Reviews.

There are 19 operating missions in the HPD portfolio. Of these, 15 are in extended mission phase, and of these 15, three will not be invited to the Senior Review. Cluster will no longer be supported by NASA, as previously determined at the two previous Senior Reviews. Geotail is largely a mission of the Japanese Space Agency (JAXA). Prior Senior Reviews saw good things in the Solar and Heliospheric Observatory (SOHO), but did not see the science as strong, so it is being moved into the infrastructure category under the R&A budget. Its operations cost about \$2.5 million per year, which is consistent with the rough average of \$2 million it costs to run a mission in its operating phase. If STEREO science can continue through the A side, the mission could regain its "green" rating despite losing the B side.

In carrying out this mandated evaluation, the Senior Review must "assess the cost and benefits of extending the date of the termination of data collection for those missions that have exceeded their planned mission lifetime." The Senior Review is the only mission review that is comparative. While there is some flexibility to shift funds from one mission to another, a termination could add more money to the pool. Terminations take approximately 18 months in order to ensure an orderly process and data archive.

The Senior Review assumes that the extended mission phase will cost around two-thirds that of the prime mission, which seems to be the case across SMD. In this upcoming Review, missions were allowed to submit an increase (overguide) to account for inflation. The Senior Review will take into account Prioritized Science Goals (PSGs). The reviewers will look at any new PSGs that the PIs present and gauge how well prior PSGs were implemented. HPD is also interested in how each mission contributed to the system observatory. The review will then recommend continuation with the current baseline, continuation with enhancements or reductions from the current baseline, or project termination.

Dr. Hayes discussed the content for extended mission proposals, which encompass the vitality of the actual instrumentation, data accessibility, and science return, among other criteria. As noted, the Review will evaluate the strength of each mission's participation in the system observatory. Dr. Hayes added that since 2009, there has been an effort to upgrade the HPD archives and standardize the data formats. That work has gone well, though now there is a volume issue.

Mission Operations and Data Analysis (MO&DA) elements cover the GI program, data and modeling, and the multi-mission operations project. The models will be subject to programmatic reviews, and the VxOs will be eliminated. The multi-mission operations project is used by some facilities and concentrates on control center functions and sustained operations infrastructure.

There have been conversations about who pays for what within NASA. This is particularly applicable to communications, which may become a factor in future Senior Reviews. For example, Voyager costs \$5 million annually to operate, but its communications link costs \$20 million per year for 6 hours of link time per day, and is paid for in another portion of the Agency. It is important to acknowledge the financial consequences of such elements, especially when dealing with old missions that have old infrastructure. Some of the numbers are fuzzy, however, and Dr. Hayes has sought precision.

The Senior Review provides findings that are input to the Division. For a mission that is in steady state and doing good science, the HPD budgeters will find a number and inflate it over time through the next 5 years. However, that number is always subject to the Senior Review. Using his example of Voyager, in 2008 the Senior Review said to find some funds because it was close to the heliopause. A big cut might kill a mission, and HPD must take into account the 22-year solar cycle in extending the data set in a uniform manner. That legacy is important to give the taxpayer full benefit.

Dr. Liemohn asked why the VxOs are being reconfigured. Dr. Hayes said that they are not consistently successful. In addition, the PIs were very narrowly focused. The virtual observatory was a joint NASA/NSF venture that did not live up to its promise. It is now primarily an APD project.

MMS Update

Dr. Paterson said that there is nothing but good news about MMS; the mission is going amazingly well. Regarding public engagement, the team developed a plan with key messages in order to convey excitement and talk about magnetic reconnection, which is a fundamental process throughout the universe. The messages explain a bit about the science and why anyone would spend money to pursue it. There were three public briefings at the launch, which were crowded. The science is not complicated, but physicists do not understand how magnetic reconnection occurs. There are also messages with vibrant images explaining how pervasive this is and where reconnection occurs in other areas.

Dr. Antiochos sought information about the level of support for MMS within NASA. Dr. Newmark explained that there were reasons why the Administrator, Charles Bolden, and Dr. Grunsfeld were not at the launch. Presence at a launch is not a good measure of engagement. Mr. Bolden supports MMS as a fundamental physics mission. Dr. Paterson agreed. He showed the rest of the public presentation, which included photographs of the spacecraft and its components, along with an animation of the launch.

There are three science objectives aimed at understanding magnetic reconnection: determine the role of electron inertial effects and turbulent dissipation in magnetic reconnection; determine the rate of magnetic reconnection and the controlling parameters; and determine the role played by ion inertial effects. The baseline science requirements are to: put four functional satellites into specific orbits; conduct science measurements in a 12 Reconnection Event (RE) dayside magnetopause orbit (Phase 1); conduct science measurements in a 25 RE nightside neutral sheet orbit (Phase 2); and obtain 16 quality reconnection events at specific parameters.

The science team includes 33 U.S. and 27 international members, and is largely organized by instrument. The objective is to get the four spacecraft in a tetrahedron separation with spacing of 10-400km. The first science phase, 1a, will start in the fall. The real mission limitation is fuel, but other science could be done if the fuel and capabilities are optimized.

Dr. Paterson described the Phase 1 science activities, in which MMS will collect three kinds of data: burst data, the data needed to satisfy Level 1 science, and fast and slow survey data. The burst data are high temporal resolution data, accounting for almost 75 percent of the telemetry but only 2 percent of the orbit. This is a prime consideration and complication of the mission. Fast survey data will help investigators identify events to study further. A recorder will take all the data, which can be kept for a week. At that point, investigators have to determine what to take down. There will be a team that can override the spacecraft data. Six months after commissioning the instrument teams must provide data to the public. Students will be involved at every level.

Dr. Paterson described the mission phases and status. Launch is complete and the initial instrument suite activation and start perigee raise operations are ongoing. The only anomaly thus far has been a data latency issue, but that was solved quickly. An instrument had a current issue that is being investigated, but the instrument is functioning fine. A timeline of the phases indicated that the MMS team will soon deploy the spin plane double probe and axial double probe boom.

Dr. McNutt observed that the spacecraft has a lot of instruments, and wondered how that factored into lessons learned thus far. Dr. Paterson said that that will take some analysis, but the key will be if the instrument teams have sufficient time. He presented a potential scenario for an MMS GI call. In ROSES 16, there will be no shortage of proposals for MMS, so he believed that that call should be fully open. However, he would like to see a special GI call for MMS in ROSES 17, contingent on the ROSES 16 response. The call could include coordination with other missions. MMS is complicated, and the science teams will be focused on figuring out their instruments. This could mean that some of the choice science is delayed.

R&A Programs Update/Assessment

Dr. Posner said that HPD continues to see high numbers of proposals to review in FY14. The reviews were affected by HPD staffing levels. Dr. Posner pointed out that the selection rate for ROSES15 will continue to be rather low. HPS had previously discussed and rejected the idea of combining the SR and GI programs for ROSES 15. However, there will be some rephrasing to improve the success rate in ROSES15 slightly. With the two-step process, HPD has reached a better (23% projected for ROSES14 vs. 18% in ROSES13) success rate of full proposals. The number of full proposals went down in ROSES14 as a result of the two-step process, but also as a response to continued low success rates taking their toll on the research community. Dr. Newmark added that the two-step process is an ongoing experiment. However, with the new funding, the Division is hopeful that the selection rate will increase. Dr. Posner said that he is concerned about people leaving the field. Notifications of remaining ROSES14 selections (H-TIDeS, H-SR solar and H-GI ODDE solar) will go out as fast as they can.

Discussion

Dr. Hagan said that HPS had previously identified several topics to pursue, and she had received some draft findings and recommendations. The Subcommittee agreed to review what was already drafted. The list included the following:

- *Differentiating between SR and GI in the ROSES call.* Text was pending for a recommendation to be included in the letter to Dr. Newmark.
- *Launch capabilities for constellations.* Text was available for review.
- *Path forward for HPD.* Text was available for review.
- *Dedicated GI call for MMS.* HPS would come back to this.
- *A finding on the new proposal process.* That had to be completed during this meeting so that Dr. Hagan could take it to the NAC Science Committee.
- *Staffing at Headquarters and the need to fully staff HPD initiatives.* This was deferred to the next meeting.
- *Comment on increased R&A funding.* Text was available for review.
- *Airborne observations opportunities.* This was deferred until after a briefing at the next meeting.
- *Final release of the Roadmap.* A statement would be drafted to the effect that HPS looks forward to the final release.

There was a unanimous vote to defer any decision about a dedicated GI call for MMS. That information would be relayed to Dr. Rowland. During further discussion, Dr. Newmark pointed out that the ROSES call already says that investigations for multiple spacecraft are encouraged. Dr. Angelopoulos advised that the language be more explicit. Dr. Newmark said that the DS promoted big science topics in order to have multi-disciplinary teams tackling big problems. That fosters use of the HSO. HPD plans on further emphasizing this in the future.

Dr. Hagan read the initial draft of the recommendation on the path forward for HPD, which sought to have SMD management communicate to the broader heliophysics community the importance of heliophysics science to NASA and the nation. In the draft recommendation, HPS also advised SMD to provide the Agency's assurance to maintain a distinct Heliophysics Division. The recommendation emphasized the importance of appointing a permanent division director who is a well-respected heliophysics scientist with the appropriate leadership experience. The consequences of no action could stagnate the program, lead to missed opportunities, and affect morale among HPD personnel and the heliophysics community.

During discussion, Dr. Newmark explained that he agreed to serve as interim director until plans are finalized. Dr. McNutt noted that the issue is not that there has been a lack of leadership, it is the lack of having a permanent division director. He cautioned against telling NASA how to do this, advising instead that they state what they wanted NASA to do. Dr. Dahlburg said that the HPS concern was primarily the need to have technical leadership. Dr. Desai mentioned the need for advocacy as well. Dr. Hagan said that this is an appropriate position for HPS to take, and she expected the other Subcommittees to support it. She noted that that support was essential in order for the recommendation to make it out of the NAC Science Committee. A revised draft would be discussed later in the meeting.

The next recommendation under discussion had to do with the HPD funding. The draft recommendation said that HPD should proceed with plans to realize the DS recommendations, including \$40 million in additional R&A funds, an Explorer cadence of every 2 to 3 years, and the addition of MOO options to future mission AOs. Dr. Hagan pointed out that this was to be a positive statement. After further discussion, HPD determined that this was a finding instead of a recommendation. It was to be redrafted for further review.

The draft recommendation addressing the two-step process proposal process said that HPD should continue using the two-step process in evaluating proposals in the GI and SR programs, and should re-evaluate having Step 1 as nonbinding once more experience has been obtained. Eliminating the two-step process will increase the burden on HPD program managers. Dr. Hagan explained that this process is being implemented to varying degrees across SMD. The NAC Science Committee is very interested in this new process, while also being divided about whether the first step should be definitive. HPD has the most experience with it.

There was considerable discussion about the recommendation from Dr. Angelopoulos about observing platforms. He noted that certain opportunities currently have limited launch flexibility and still operate at the Explorer cost cap. This stymies small and innovative missions that have new and expanded capabilities. Dr. Angelopoulos sought to have HPS endorse the idea of allowing launch costs to become part of the proposer's launch costs in order to enable new opportunities. He explained that a secondary payload going into a different orbit from the primary must meet certain requirements that are more applicable to launch vehicles. While the AOs allow secondary opportunities, getting those launched can pull in regulations that otherwise would not apply.

Dr. Antiochos noted that HPD was not the part of NASA impeding this, and Dr. Hagan said the initial draft of the recommendation was too detailed to take to the NAC Science Committee. Dr. Angelopoulos suggested stating that NASA should explicitly allow Payload Adapter Fittings (PAFs) as part of the delivery mechanism and enable proposers to use some or all of the NASA launch services cost savings to pay for the PAF costs, stating those costs for the Explorer call. NASA should exclude PAF costs from the strict reliability constraints related to the launch services and instead subject them to risk reduction requirements akin to spacecraft propulsion subsystems and risk assessment of the individual mission.

Dr. Hayes was concerned that this might be introducing conjunction assessment, which has an annual cost. This is an issue that is bad and getting worse, especially with constellations and cubesats. HPD costs in this area are small, but they will rise, and the communications network is still an issue. There is no infrastructure for a constellation that is dispersed. Dr. Hagan asked that this recommendation be revised for further discussion later in the day.

HPS Working Time to Develop Findings

Once discussion resumed, HPS took a new look at the two-step process recommendation. Dr. Dalhburg was unavailable at the time, but otherwise HPS voted unanimously in favor of the recommendation.

A revised HPD plan recommendation was presented, discussed, and set aside pending additional edits. HPS members agreed that the interim leadership has been excellent, which is why the recommendation referred to "permanent" leadership rather than "stable" leadership.

While the HPS members each received a printed copy of the Roadmap on the first day of the meeting, that preproduction version was still being cleaned up and had not yet been put on the website or otherwise issued to the public. The HPS statement said that they applauded its imminent release. This was issued in the form of a commendation to be included in the official letter. Dr. Hagan noted that many in the community had worked on the document for a long time, and HPS had approved it a year ago.

Dr. Hagan asked that the Subcommittee next address the G/MOWG finding on the separation of the GI and SR programs. Dr. Kessel said that ROSES currently states that the highest priority goes to a combination of data modeling and analysis that addresses DS goals. The bigger program has traditionally been SR. It must have a data component, though that does not have to be large. The GI and SR proposals that come in are hard to distinguish from each other.

Dr. Liemohn said that the January teleconference presentation showed very little overlap in proposals, indicating that investigators know where they should submit. Dr. Kessel said that the community self-selects into SR or GI, but it is not possible to distinguish among the proposals just by reading them. They all have data, and they all have theory and modeling. Dr. Antiochos gave an example of how the work in GI and SR would differ in the area of solar prominences.

Dr. Kessel said that the GI program does not use archival data to the same extent as SR, but both tend to use the latest data. The last time HPD constrained it, the community was unhappy. Dr. Paterson added that access to data has evolved. It had been the property of the PI, and now it must be able to be accessed quickly. Dr. McNutt said that PSD has participating scientist programs like HPD's GI program, in which the investigators have access to the data before it enters the archives. The scientists are de facto co-investigators added late. Dr. Kessel said that HPD has nothing equivalent to that now. Dr. Paterson explained that mission teams were told to go to the GI program for help in getting their data analyzed.

Dr. Liemohn suggested that the GI program should embed a percentage of the work plan for analysis of current operations. If that percentage is not an option, the proposal should go to the SR program. Dr. Tobiska was concerned that a hard percentage target would be artificial, and Dr. McNutt added that it could be difficult to implement. He saw two potential directions. First, the GI program could be for spacecraft that are still functioning and the SR program could be for data from spacecraft that are no longer functioning. Another way to break it out would be by spacecraft in their prime missions versus those in extended mission.

Dr. Kessel said that HPD wants to fund the best science. An artificial divide could lead to an imbalance in which some lesser science is funded instead. She understands wanting both the GI and SR opportunities, but having a lot of money in a merged entity would be positive. Dr. Antiochos said that in order to have the best science, HPD needs a GI program for the HSO and should require that proposals state the percentage of time and funds spent on data analysis. Dr. Dahburg said that a PI will try to fit into one bucket or another. Dr. Kessel asked if it would make sense to have the GI program for large missions, with SR being more system oriented. She encouraged other ideas, including those that go beyond the status quo.

Dr. Hagan concluded that the Subcommittee would not come to closure on this before the end of the meeting. She advised thinking more deeply and asking HPD staff to present briefings on the models they have considered. It would be good to look at the issue from different angles and think about how to move the discipline forward. She wanted to engage the community as well. HPS does need to weigh in before the 2016 call, however. Since HPD will begin work on that call in September, this would be a topic for the summer meeting. Dr. Kessel said that the Division staff could present some alternatives then.

Next, HPS voted on the recommendation praising the imminent release of the Roadmap. The vote was unanimous in favor of the recommendation.

The revised recommendation regarding NASA's support for heliophysics stated that SMD should communicate to the broader heliophysics community the importance of heliophysics science to NASA and the nation. The communication should assure the community that SMD will continue to maintain a distinct heliophysics division and will plan to provide permanent leadership for the division. As with previous appointments, the HPD director should be a highly experienced, well-respected heliophysics scientist. The HPS vote in favor of this recommendation was unanimous.

On the praise for the increased R&A funding, the finding stated that such funding is a high priority objective of the DS, allowing the heliophysics community to effectively address the DS science objectives. The vote was unanimous in favor of the finding.

The draft recommendation addressing secondary payloads and propulsion was set aside for further editing and discussion following the debrief with Dr. Newmark.

Debrief with Heliophysics Division Director

Dr. Newmark thanked the Subcommittee members for their work. Dr. Hagan identified topics HPS deferred to the future: airborne observations; staffing needs of HPD, especially as the budget grows; how the MMS GI funding will be handled once the mission is fully operational; and the distinction between SR and GI elements. The last item is a high priority item for the next meeting.

Dr. Hagan asked HPS members to summarize the four completed findings and recommendations, noting that they were still at work on a fifth. First was the vision for the path forward for HPD. Dr. Desai said that this was a recommendation to take to the NAC and SMD management, advising the latter to communicate to the heliophysics community about how important the field is to NASA and the nation, and to provide assurance that heliophysics will remain a distinct division, with a plan for permanent division leadership by a director with a high level of experience in heliophysics as a scientist.

Dr. Hughes said that the recommendation on the two-step proposal process was to continue it and keep the first step as a nonbinding encourage/discourage decision until HPD has more experience and data. Dr. Hagan noted that some proposers will not do due diligence in Step 1, and HPS sees this as a flaw that could become a growing issue. The vote for the recommendation was not unanimous, and HPS anticipates returning to this issue.

Dr. Hughes also explained the finding about the Roadmap release, in which HPS applauds its imminent release and notes that timely release maximizes its usefulness. Dr. Antiochos summarized the fourth finding, in which HPS applauds the leadership on the plan to follow priorities of the DS, and the investment of more funds into R&A.

Dr. Hagan added that HPS was still working on a recommendation about expanding opportunities for access to space. Dr. Angelopoulos elaborated, saying that they had discussed the potential use of upcoming Explorer AOs for secondary payloads using fueled PAFs to different orbits from those of the prime missions. The recommendation advises HPD to be explicit about this in AOs, which should recognize that funds from the payload not using a launch vehicle can be made available and applied to the PAFs. The recommendation also calls for the reliability requirements to not be the same as those for a standard launch vehicle.

Dr. Hagan said that she was very proud of the Subcommittee, which had done a lot of work. Dr. Newmark thanked them for their hard work and the findings. He also thanked the Roadmap committee and others. All of their efforts help enable an exciting future.

Discussion, Including Future Meeting Dates, Potential Agenda Subcommittee Topics, Action Items

After looking at potential meeting dates, the Subcommittee members focused on late June for the summer meeting. Dr. Hagan noted that this was Dr. Hughes' last meeting and that she will no longer be chair.

Dr. Hagan asked if there were any other topics HPS members wanted to hear about or discuss at the next meeting. Dr. Murphy asked for a briefing of an interstellar probe mission that was part of a CalTech study involving many disciplines, including heliophysics. Dr. McNutt, who was heavily involved in that project, said he could easily make a presentation and discuss new developments. Dr. Dahlburg mentioned the OSTP interest in space weather. Dr. Kessel told the Subcommittee to send her any additional ideas.

After further work on the finding about secondary payloads, it stated that future Explorer AOs should explicitly enable the use of fueled PAFs as part of the delivery mechanism. Any funds saved by not using a dedicated launch vehicle should be made available for the secondary payload delivery mechanism, thereby enabling new science. This is in the spirit of the DS recommendation to implement the DRIVE initiative, calling for diversification of observing platforms with microsats. Fueled PAF delivery has the potential to enable a wider range of orbits within the Explorer line. The reliability of a fueled PAF system can be assessed as part of mission development in the same way as an onboard propulsion system. A wide range of orbits would be unavailable if fueled PAFs are not used for new science, particularly for smaller spacecraft missions or constellations.

Dr. Hagan said that there would be further work done to this finding. The Subcommittee vote was unanimous in favor of the finding.

Adjourn

Dr. Kessel thanked Dr. Hagan for her leadership. The meeting was adjourned at 3:51 p.m.

Appendix A Attendees

Heliophysics Subcommittee members

Maura Hagan, Chair, National Center for Atmospheric Research

Vassilis Angelopoulos, UCLA

Spiro Antiochos, NASA GSFC

Jill P. Dahlburg, Naval Research Laboratory

Mihir Desai, Southwest Research Institute

W. Jeffrey Hughes, Boston University

Michael W. Liemohn, University of Michigan (via teleconference)

Ralph L. McNutt, Jr., Johns Hopkins University

Neil Murphy, JPL

James Russell III, Hampton University

W. Kent Tobiska, Space Environment Technologies

Ramona Kessel, NASA HQ, Executive Secretary

NASA Attendees

Max Bernstein

Jeffrey Hayes

Willis Jenkins

James Klimchuk

Guan Le

Robert Leamon

John Lee

Jeff Morrill

Jeffrey Newmark, HPD Director

William Paterson

Arik Posner

Doug Rowland

Jenny Rumburg

Diego Sanchez

Sandra Smalley

(illegible, last name starts with T)

Dan Woods

Geoffrey Yoder

Other Attendees

J. Eric Grove, Naval Research Lab

Elizabeth Sheley, Zantech IT

Ana Wilson, Zantech IT

Appendix B
Subcommittee Membership

Maura Hagan (Chair)

National Center for Atmospheric Research
Boulder, CO

Ramona Kessel (Executive Secretary)
NASA HQ

Vassilis Angelopoulos
UCLA

Spiro Antiochos
NASA GSFC

Jill P. Dahlburg
Naval Research Laboratory

Mihir I. Desai
Science and Engineering Division
Southwest Research Institute

W. Jeffrey Hughes
Astronomy Department
Boston University

Michael W. Liemohn
University of Michigan

Ralph L. McNutt, Jr.
Johns Hopkins University

Neil Murphy
JPL

James Russell III
Hampton University

W. Kent Tobiska
Space Environment Technologies

Appendix C

Presentations

1. *NASA Heliophysics Division Update*, Jeffrey Newmark
2. *FY16 President's Budget*, Jeffrey Newmark
3. *Flight Program Status*, Sandra Smalley
4. *Terrestrial Gamma-Ray Flashes*, Eric Grove
5. *G/MOWG Findings*, Douglas Rowland
6. *Heliophysics-GI Two-Step Experiment*, Mona Kessel, Arik Posner
7. *Heliophysics Mission Senior Review Charge to Panel*, Jeffrey Hayes
8. *MMS Update*, William Paterson
9. *Heliophysics R&A Update*, Arik Posner

Appendix D
Agenda

**Heliophysics Subcommittee Meeting
March 30-31, 2015**

Monday March 30

9:00	Welcome, Overview of Agenda	M. Hagan, HPS Chair
9:15	Heliophysics Division Overview (including Roadmap update)	J. Newmark, NASA HQ
10:00	Heliophysics Director Update	G. Yoder, NASA HQ

10:15 BREAK

11:00	Budget Update	J. Newmark, NASA HQ
11:30	Flight Program Status	S. Smalley, NASA HQ

12:15 LUNCH: Science Presentation: Terrestrial Gamma-ray Flashes: Dark lightning and other radiation from thunderstorms, Eric Grove/NRL

1:30	G/MOWG report	D. Rowland, NASA GSFC
2:00	Two-step process update/assessment	M. Kessel/A. Posner, NASA HQ

3:00 BREAK

3:15	Discussion of two-step process	Subcommittee
5:00	ADJOURN	

Tuesday March 30

9:00	Senior Review Guidelines	J. Hayes, NASA HQ
9:30	MMS Update	B. Paterson, NASA HQ
10:00	R&A programs update/assessment	A. Posner, NASA HQ

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10:30 Discussion of SR and GI programs

Subcommittee

12:00 LUNCH

1:15 HPS working time to develop findings

Subcommittee

3:15 Discussion, including future meeting dates,
potential agenda topics, action items

Subcommittee

3:30 Debrief with Heliophysics Division Director

J. Newmark, NASA HQ

4:00 ADJOURN